

# Active Twist Control for a Compliant Wing Structure Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



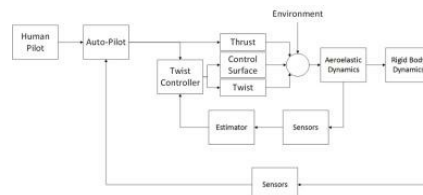
## ABSTRACT

Blended wing body (BWB) aircraft provide an aerodynamically superior solution over traditional tube-and-wing designs for a number of mission profiles. These platforms provide an all-lifting surface with a reduced wetted area, which lead to significant aerodynamic improvements over their conventional counterparts. However, due to their lack of a conventional tail surface with which to trim in pitch during low-speed operations, these aircraft suffer from a number of stability issues. Chief among these issues is the potentially catastrophic loss of feedback – normally a function of the tail surfaces – when the wing stalls at high angles of attack. This problem is further manifested through the large variation in stall behavior across the BWB's wingspan due to significant thickness differences between the payload-carrying centerbody and the aerodynamically efficient outer wing portions of the vehicle. Aurora Flight Sciences, in collaboration with Professor Mircea Teodorescu of the University of California at Santa Cruz, proposes an actively twisted compliant wing architecture for BWB aircraft that mitigates the stall concerns typically associated with these platforms while providing a significant increase in aerodynamic efficiency. The practical implication resulting from this novel approach is a state-of-the-art compliant wing architecture that provides active control of the twist along the span of the wing by sensing and appropriately responding to oncoming stall risks, thereby eliminating the need for outer wing washout and drastically improving the aerodynamic performance of the wing during cruise. These innovative concepts will be used to complete a preliminary design and build of the wing structure for proof-of-concept flight testing by the end of Phase I.

## ANTICIPATED BENEFITS

### To NASA funded missions:

Potential NASA Commercial Applications: Retrofitting current NASA UAV platforms with the compliant wing technology would

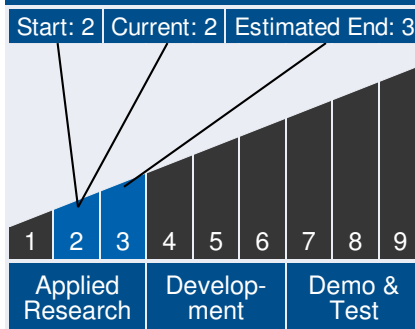


Active Twist Control for a Compliant Wing Structure

## Table of Contents

Abstract . . . . .	1
Anticipated Benefits . . . . .	1
Technology Maturity . . . . .	1
Management Team . . . . .	1
Technology Areas . . . . .	2
U.S. Work Locations and Key Partners . . . . .	3
Details for Technology 1 . . . . .	4

## Technology Maturity



## Management Team

### Program Executive:

- Joseph Grant

### Principal Investigator:

- Cory Kays

# Active Twist Control for a Compliant Wing Structure Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



create revenue, both while opening compliant wing technology development for the next advanced aircraft, whether it be a transport-sized BWB platform or a smaller UAV system. NASA's efforts on the development of next generation commercial transport aircraft have shown a clear trend towards unconventional designs, including the strut-braced SUGAR concept and the Aurora/MIT D8 double bubble design configurations. While the BWB configurations could clearly benefit from the actively twisted compliant wing technology, the other unconventional platforms require enabling technologies in aeroelastic control and dynamic load alleviation to realize their full potential; the actively controlled compliant wing technology proposed for this effort – whether it be the fully integrated system or simply standalone components developed over the course of the effort – could be leveraged for integration into these next-generation platforms. Opportunities exist, through Aurora's heavy involvement with the development of the D8 concept, to implement the wing architecture on demonstrator programs for these next-generation concepts. These demonstration opportunities would allow a maturation of the technology, easing the transition to eventual fielding of the technology in the commercial or military sector, and providing NASA with an invaluable technical role in the development of this enabling technology.

## Technology Areas

Robotics and Autonomous Systems (TA 4)

└ Adjustable Autonomy (TA 4.5.5)

### To the commercial space industry:

Potential Non-NASA Commercial Applications: After the active twist architecture has been thoroughly vetted through integration into Aurora products, Aurora will aim to sell both the compliant wing structure construction methodology and the active twist control system architecture to outside customers as a stand-alone product, as well as an integrated system. Aurora will act as both the manufacturer and as a value added reseller, customizing integration and installation methods and refining the onboard control algorithms as appropriate for the intended use of the active control technology. Depending on configuration selection, this system could be packaged a wing architecture to

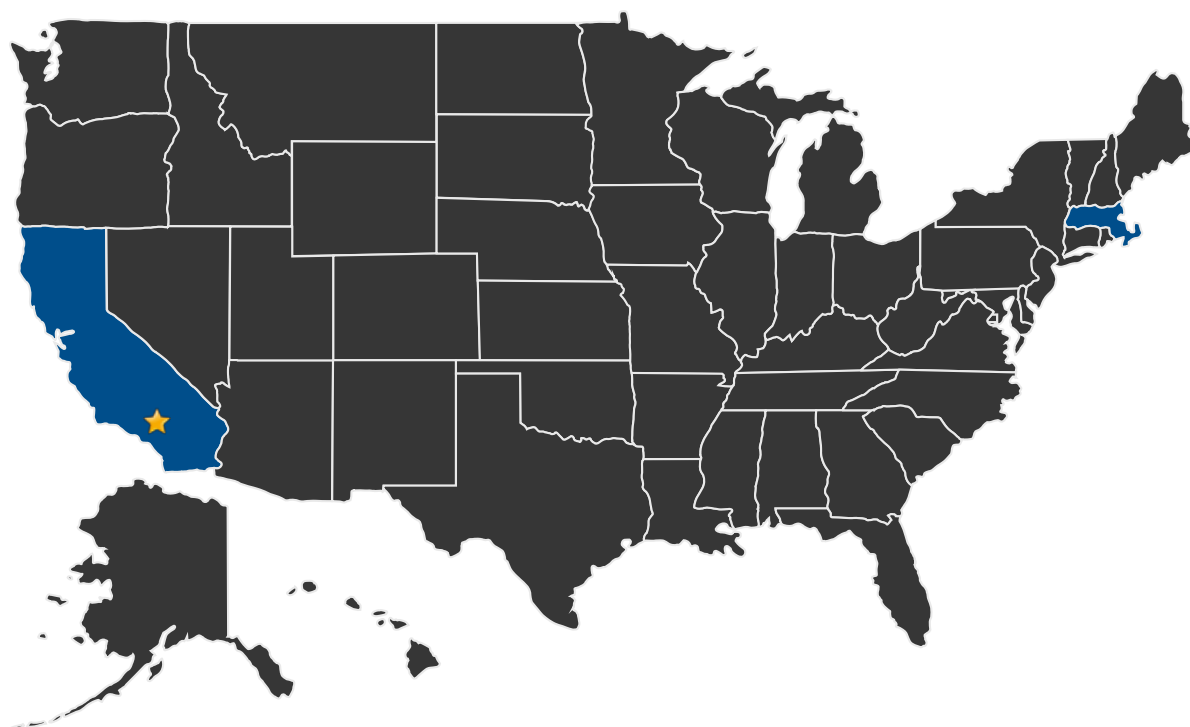
# Active Twist Control for a Compliant Wing Structure Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



be retrofitted on existing aircraft or the wing technology could be incorporated early in the design process of a ground-up aircraft development. Additionally, the technology could be a customized system where Aurora partners closely with a customer to tailor the actively controlled compliant structure to specific aircraft needs, such as integration into a self-aware vehicle or for prognostic health monitoring systems. Finally, BWB platforms have been shown to meet the next-generation requirements of several military aircraft, including the tanker and the bomber. The active twist technology would be a crucial to realizing the full potential of such platforms; therefore, efforts could be made to partner with large contractors to integrate the active twist technology onto these next-generation military vehicles.

## U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

★ Lead Center:

Armstrong Flight Research Center

### Other Organizations Performing Work:

- Aurora Flight Sciences Corporation (Manassas, VA)
- University of California, Santa Cruz (Santa Cruz, CA)

# Active Twist Control for a Compliant Wing Structure Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



## PROJECT LIBRARY

---

### Presentations

- Briefing Chart
  - (<http://techport.nasa.gov:80/file/17861>)

## DETAILS FOR TECHNOLOGY 1

---

### Technology Title

Active Twist Control for a Compliant Wing Structure